

Proposal/Request for
OPERA Brick Studies in the Near Detector
Hall

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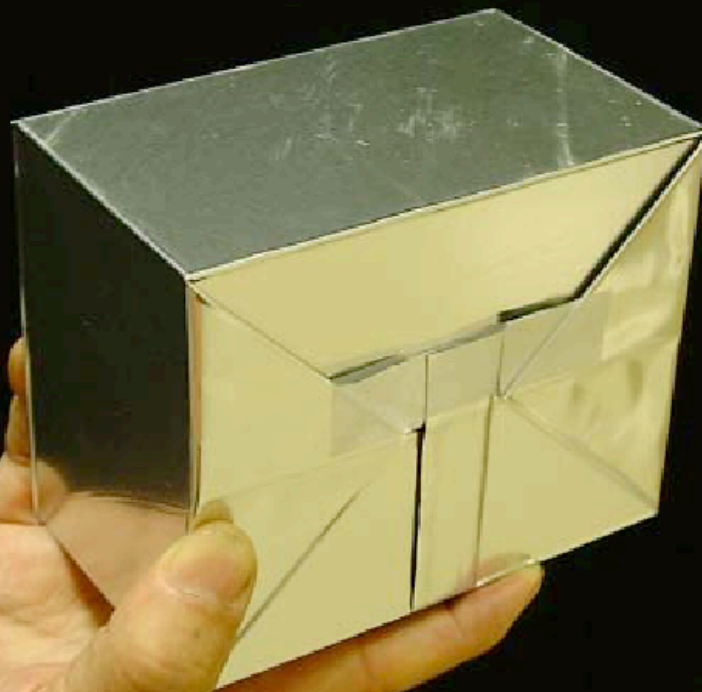
January 7, 2005

Outline

- Overview/introduction
- Status of request
- Installation plan
- Exposure plan
- Potential results

OPERA Bricks

Element of the detector
ECC Brick (8.3kg)



Vacuum Packed

Brick dimensions :

12.5x10.0x7.5 cm³

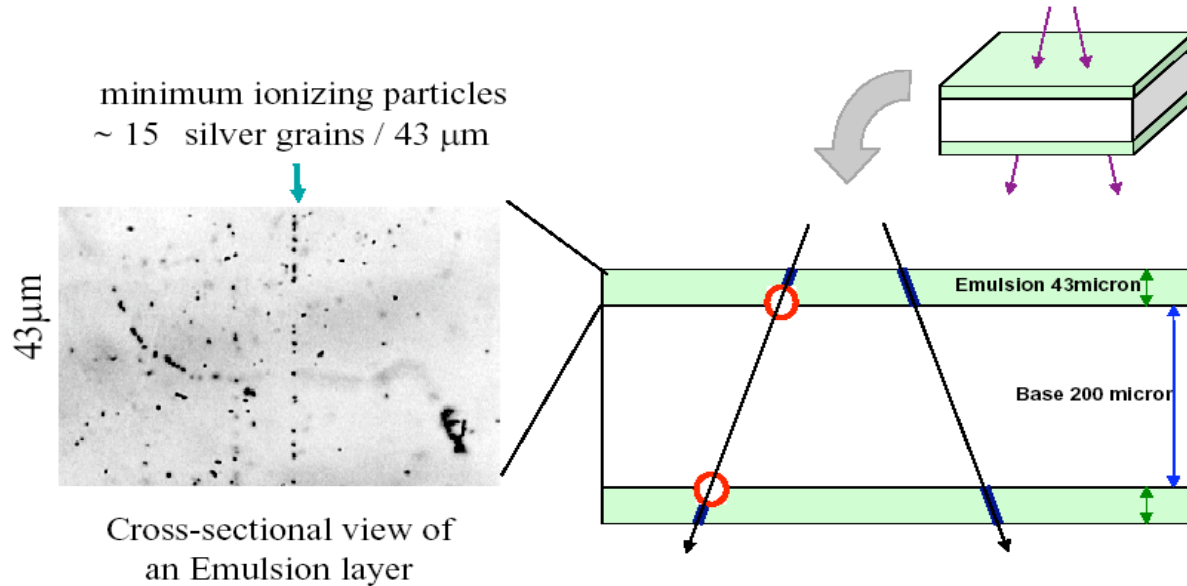
Contents :

56 (1mm) plates of
passive material
(i.e. Pb or Fe)
alternating with
emulsion films

Emulsion films:

produced by Fuji
43 μm layers on
200 μm plastic
base

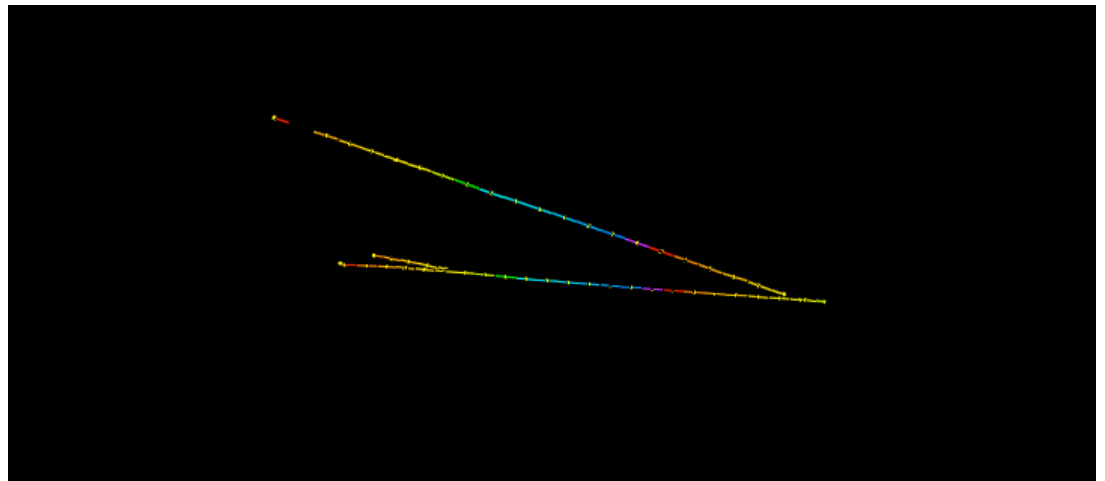
3D vector tracker with sub-micron accuracy



Reconstruct neutrino interaction vertex at micron level resolution
⇒ can actually “see” and measure the primary multiplicity

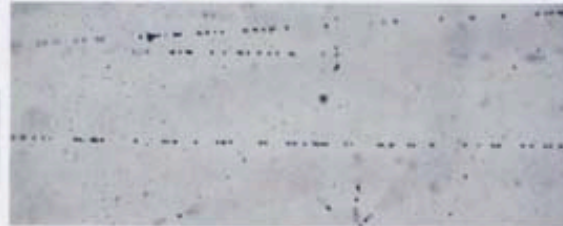
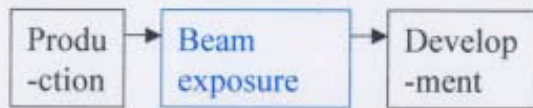
Measure primary track momentum using multiple scattering

Identify electrons/gammas by shower development



Performance of emulsion films for OPERA

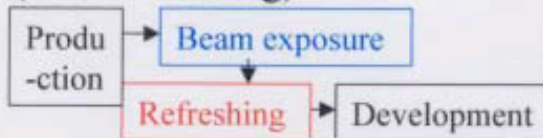
Initial sensitivity



G.D.
36/100 μm

F.D.
1.3/1000 μm^3

Characteristic of refreshing (after refreshing)

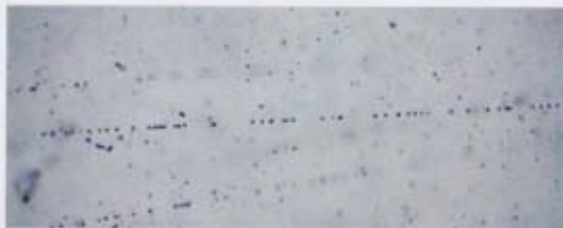
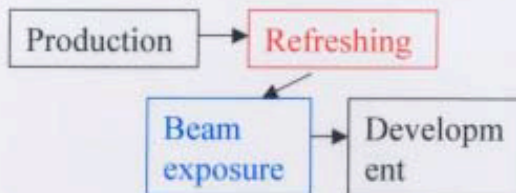


G.D.
Under 8/100 μm

F.D.
2.1/1000 μm^3

Condition : 30°C 98% 3days

Sensitivity of refreshed film



G.D.
35/100 μm

F.D.
1.5/1000 μm^3

no aging

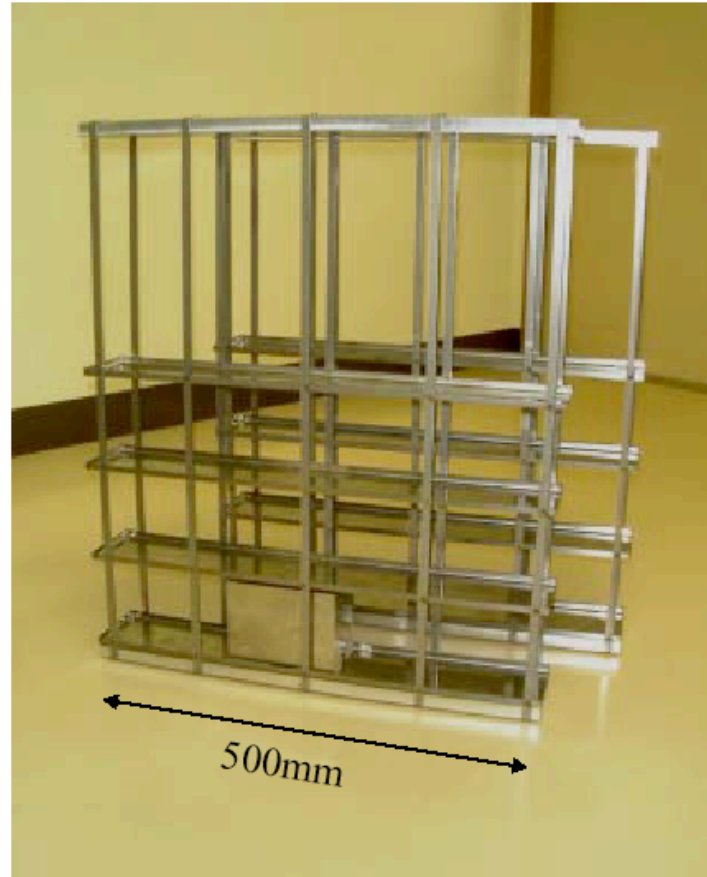
OPERA bricks en route Nagoya to Gran Sasso



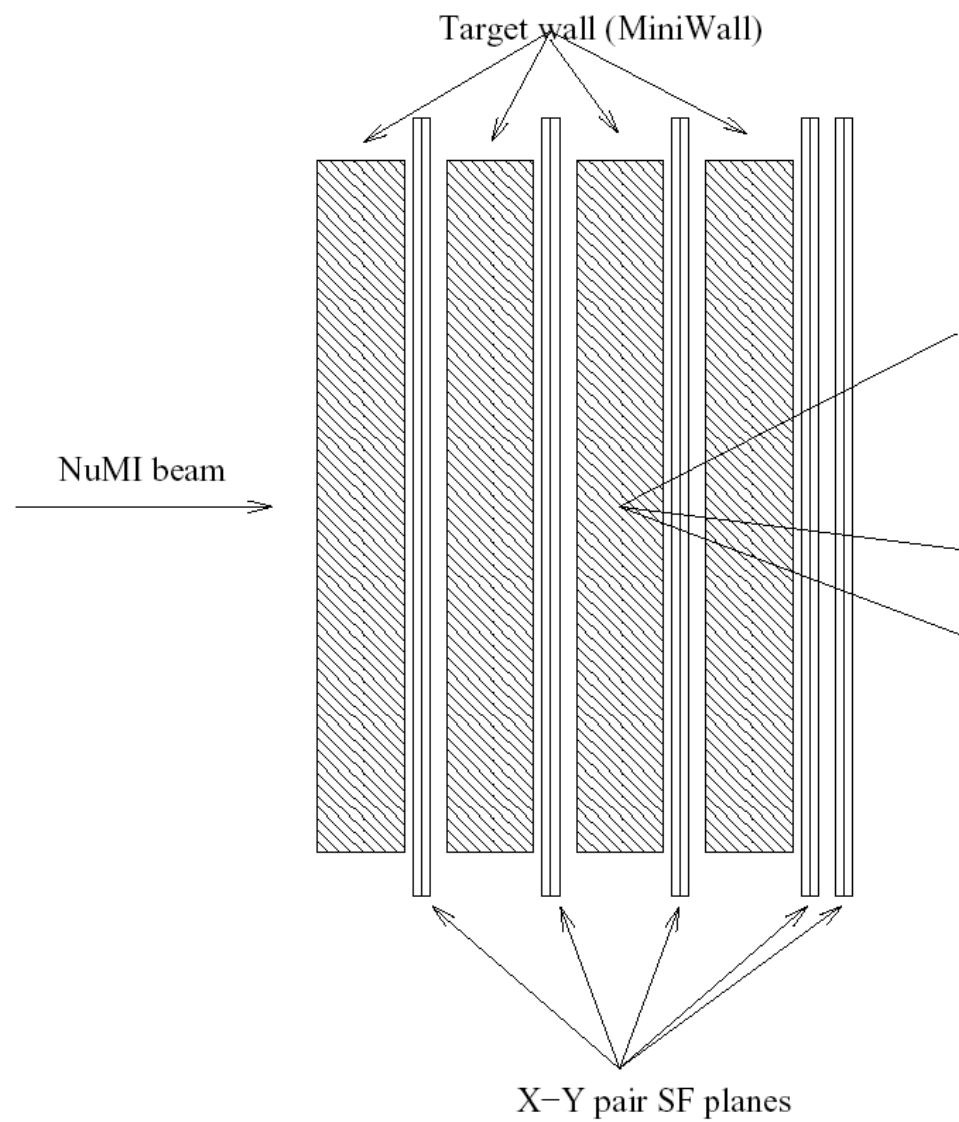
Basic Idea : 1) install 4 walls of bricks in NuMI beam,
just upstream of the Near Detector

MiniWall : named after OPERA target wall
Each MiniWall contain ~~4x4=16~~ ECC brick.
 $4 \times 3 = 12$

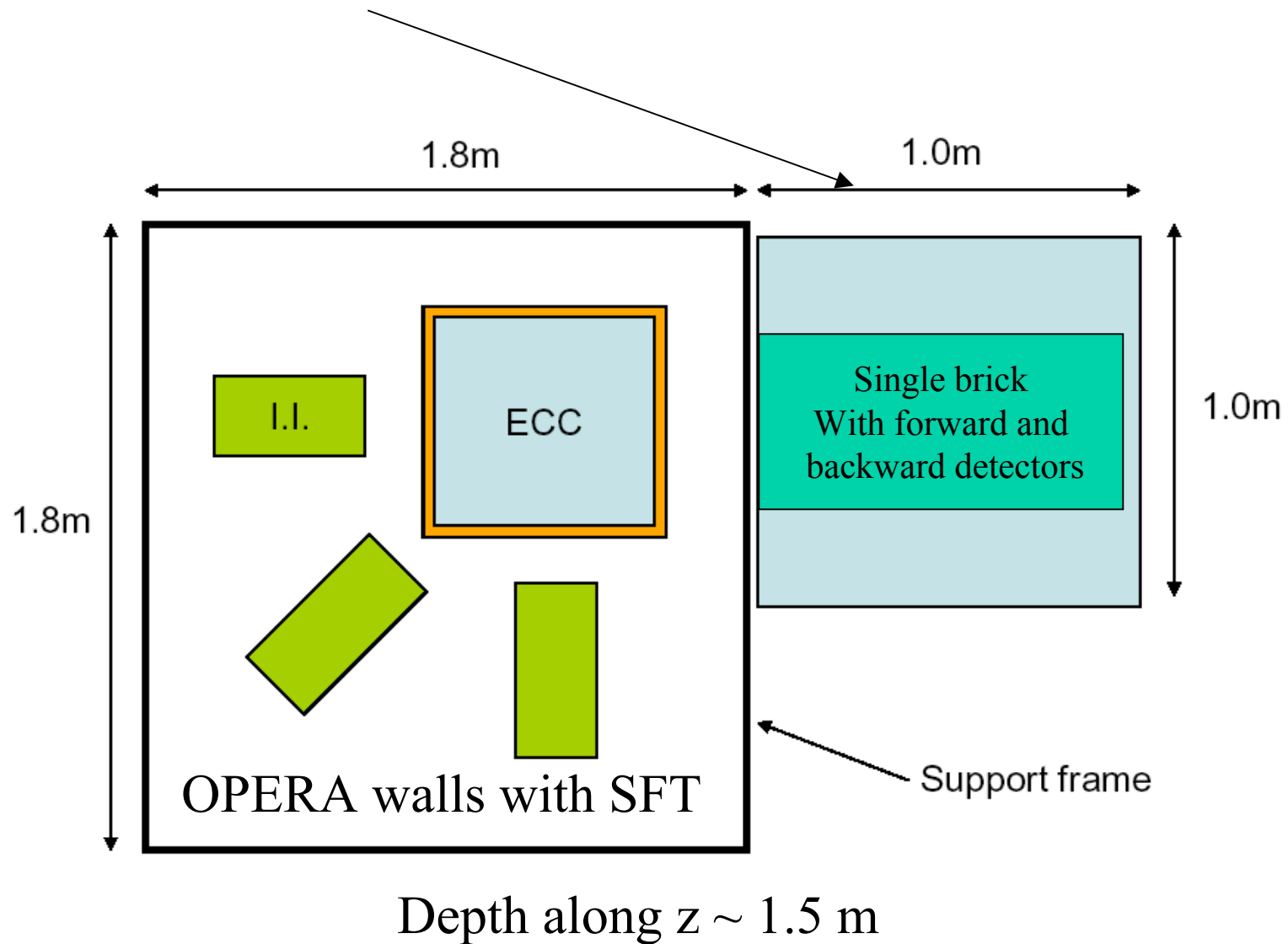
~400 kg



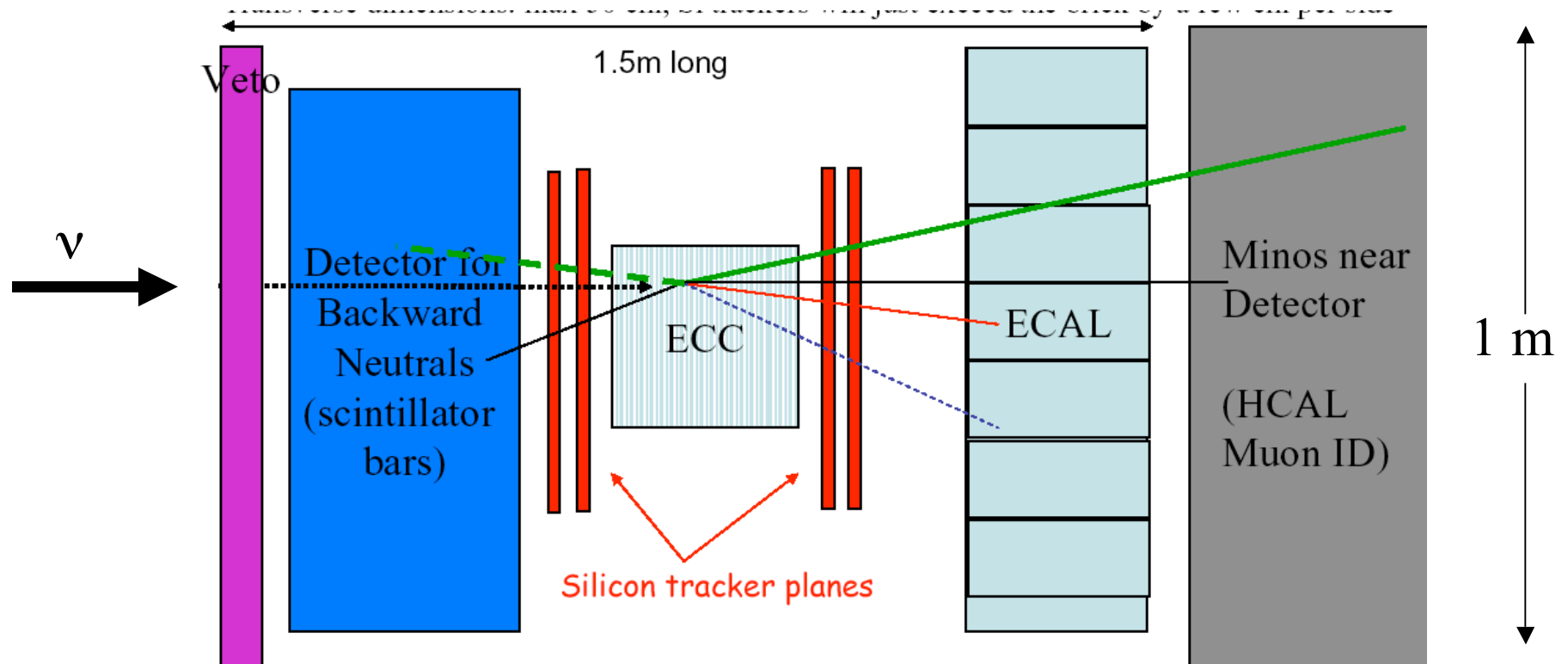
Interleave DONUT SF Tracker between walls



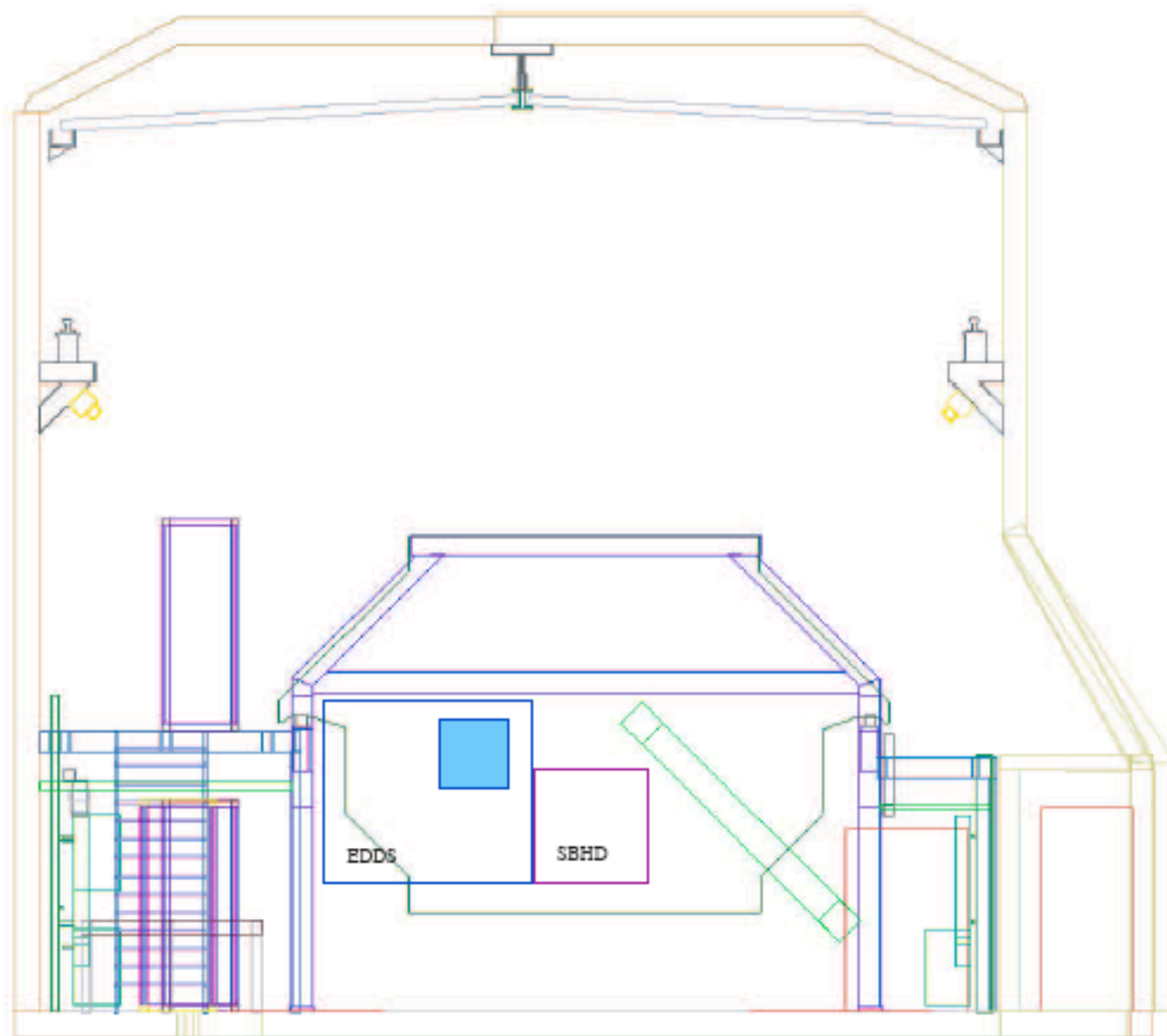
Idea 2) single brick with forward & backward detectors



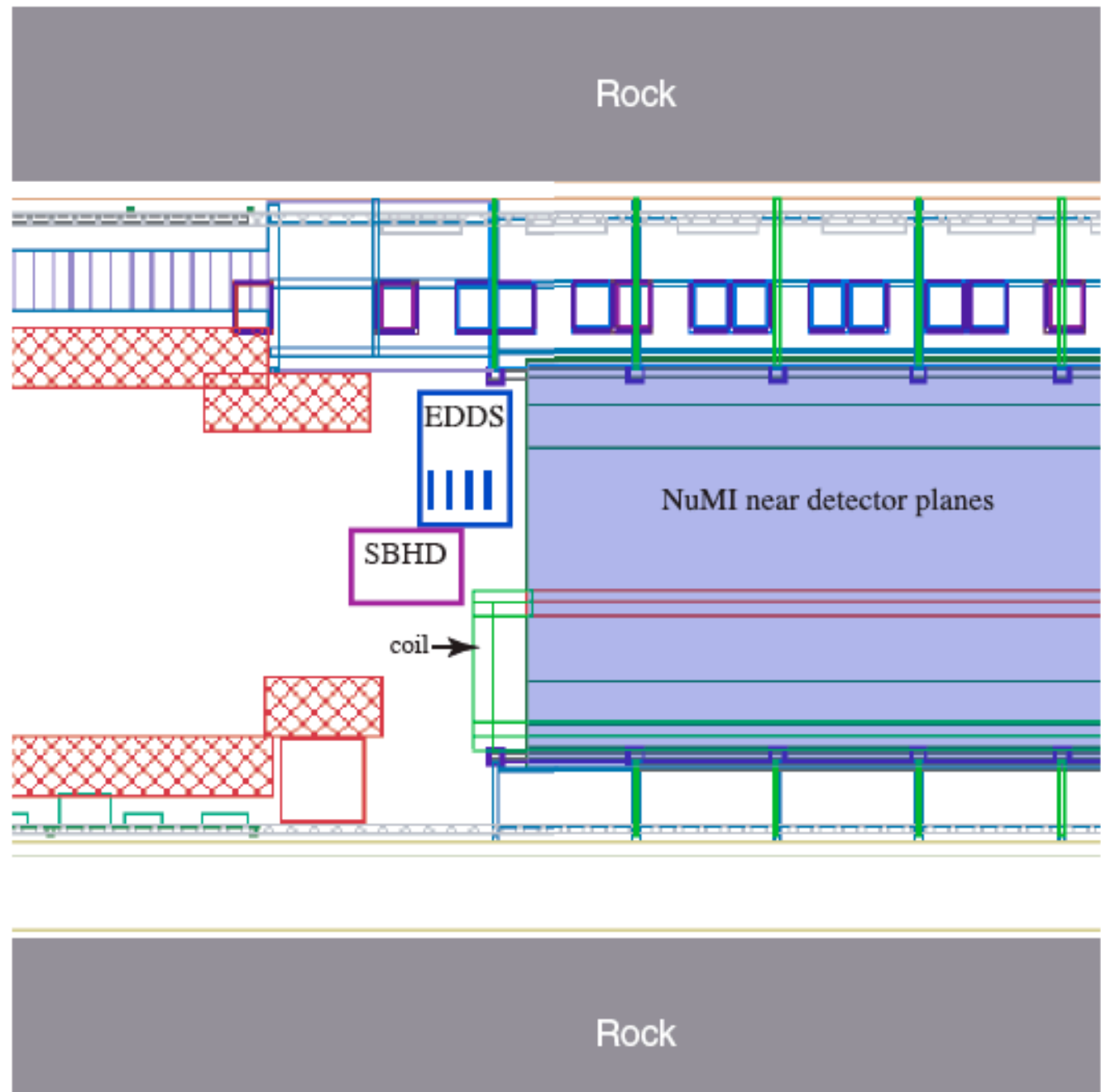
Single Brick (Lyon)

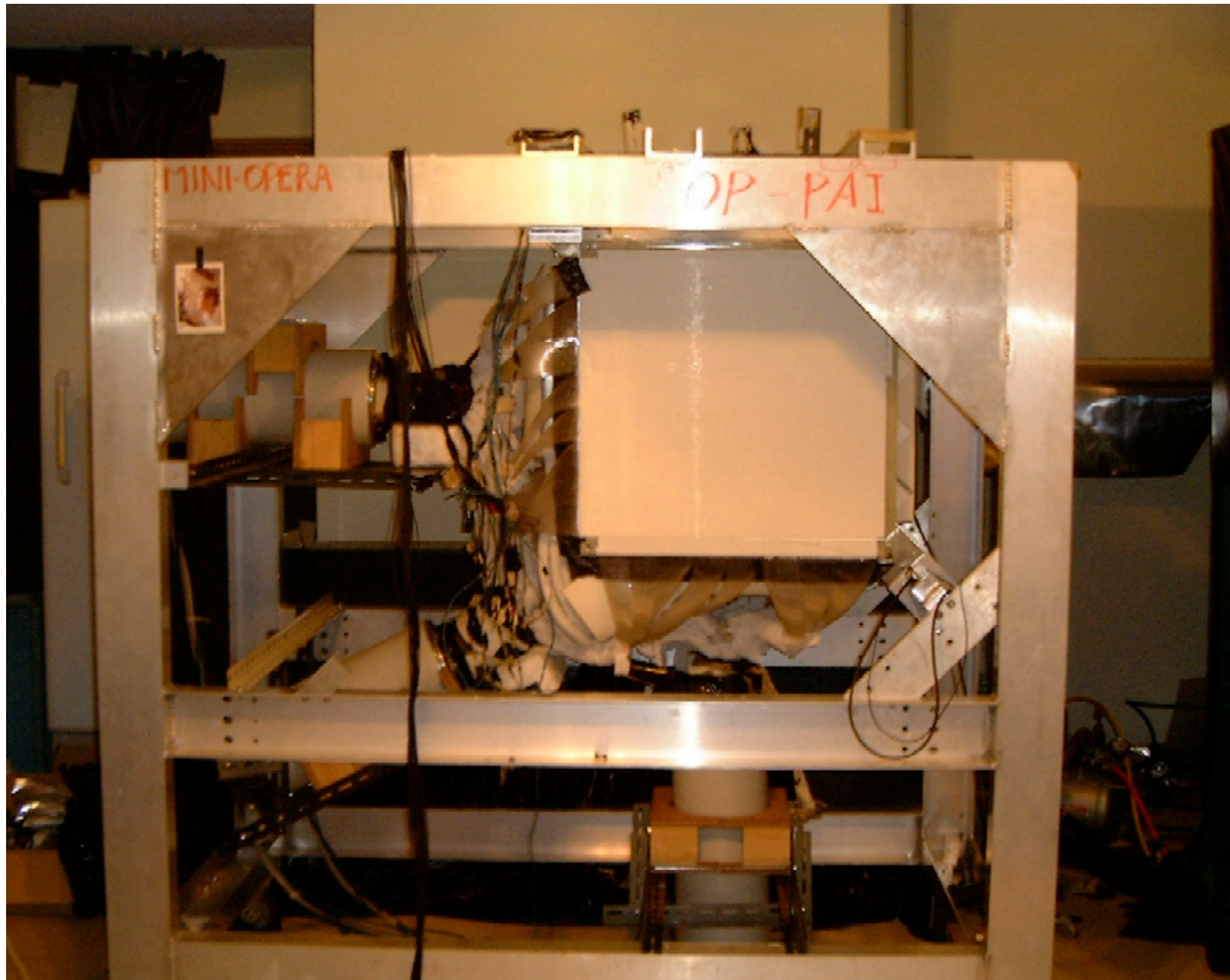


All detectors are recycled components from CHORUS



Plan View





25/Dec./2004

Status of Request

- Informal discussion of idea in Spring 04
 - Presented by M. Komatsu (Nagoya) at last March collaboration meeting parallel session
- Formal document prepared Fall 04; submitted to Program Planning, circulated to MINOS ExCom
 - Program planning circulated to Division/Sections for review as a test beam initiative;
 - Received preliminary comments from ES&H
 - Emulsion processing requirements
 - Indicated requirement will be a detailed MOU and impact analysis by potentially affected parties i.e. MINOS
- Winter 04-05 :
 - Posted document for collaboration review
 - Parallel session yesterday
 - Discussion at this meeting

Installation Requirements

- Aluminum support structures to elevate detectors to beam height
- Electrical outlets
- Place detectors

EDDS	120V
Readout II	0.1kW
NIM bin	0.4kW
DAQ host PC	0.3kW
misc.	0.2kW
Sub total for 120V	1.0kW
SBHD	240V
NIM bin	0.3kW
VME bin	1.0kW
PCs	0.6kW
Various	0.6kW
Sub total for 240V	2.5kW
Total	3.25kW

Expected Event Rates

From D. Michael Nov. 04 PAC talk

Apr-June 05	0.2 - 0.35	e20
thru 05 shutdown	0.5-0.8	e20
by April 06	1.3 - 2.0	e20
2006	2.4	e20
2007	2.8	e20
2008	3.0	e20
2005	3.5	e20



Use 1.5e20
POT to calculate

Yields $\sim 25\text{K } \nu_\mu \text{ CC}; 200 \nu_e$

Exposure Plan

- Begin with 48 bricks (12 per wall) +1 (SBHD)
- Walls 1 and 2 : OPERA studies
 - 1 mm Pb passive absorber
 - Exchange 1 wall per week for 20 weeks
- Walls 3 and 4 : NuMI Beam characterization/neutrino studies
 - Fe absorber, can be changed to do other studies
 - Integrate for ? Weeks (? Tbd)
- SBHD : extract and replace brick ~daily
- Extracted bricks get reconfigured with new films and can then be reinstalled
 - Film development
 - New film refreshing and brick assembly

“Connection” to MINOS

- Wall/SFT set-up (Nagoya)
 - SFT used to predict interactions in a brick.
 - Each beam spill is time stamped in the SFT data readout
 - If a neutrino interaction is LOCATED (after emulsion scanning and reconstruction),
 - Look in MINOS data and see if there is a muon for that spill which is plausibly connected
 - Nagoya will make all emulsion data available [digitized m-files (all segments) and vertex/track location - DONUT style data]
- Single Brick set-up (Lyon)
 - *Need to check on this; initial request similar*

Summary & Plans

- Complete defining all requirements for installation and operation
 - Electrical requirements underground
 - Emulsion development (muon lab dark room)
 - Refreshing facility (? underground)
- Address any concerns or issues uncovered by MINOS collaboration
- Develop Test Beam MOU, provide all documentation required for safety reviews
- Set up funding method : request states that funding for all activities will be provided by Japan and Lyon
- Possible schedule : begin ~ May, go till shutdown, evaluate progress and determine whether continuing is beneficial